Part-5-Recommend_Model

December 21, 2021

1 Recommendation Techniques and Results

In this file, using merged data of game and player we develop the working recommendation system

[ ]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline

from scipy import sparse

from lightfm import LightFM
from sklearn.metrics.pairwise import cosine_similarity
from lightfm.evaluation import precision_at_k
from lightfm.evaluation import auc_score

from scipy.spatial import distance

from sklearn.manifold import TSNE
from gensim.models.keyedvectors import Word2VecKeyedVectors
import textwrap

from support_function import *

#Import Warnings
import warnings
warnings.filterwarnings("ignore")
```

Load the supported function from support_function.py file in this notebook.

[ ]:
```
%run support_function.py
```

1.1 Get the Data For recommendation from cvs file.

We load the csv file which contain the userId and game id in it.

[ ]:
```
user_recom_data = pd.read_csv('recdata.csv', index_col=0)
user_recom_data = user_recom_data.rename(columns = {'variable':'id', 'value':␣
↪'owned'})
```

```python
user_recom_data.head()
```

[ ]:

```
   uid  id  owned
0    0  10    1.0
1    1  10    1.0
2    3  10    1.0
3    4  10    1.0
4   10  10    1.0
```

We load the games data with names and all other information like geners

[ ]:

```python
# Load games data
game_recom_data = pd.read_csv('gamesdata.csv', index_col = 0)
game_recom_data.head()
```

[ ]:

```
          publisher                                             genres  \
0        Kotoshiro  ['Action', 'Casual', 'Indie', 'Simulation', 'S…
1  Making Fun, Inc.       ['Free to Play', 'Indie', 'RPG', 'Strategy']
2      Poolians.com  ['Casual', 'Free to Play', 'Indie', 'Simulatio…
3                                  ['Action', 'Adventure', 'Casual']
4              NaN                                                NaN

                  app_name                    title  \
0      Lost Summoner Kitty      Lost Summoner Kitty
1                Ironbound                Ironbound
2  Real Pool 3D - Poolians  Real Pool 3D - Poolians
3                    2222                     2222
4            Log Challenge                      NaN

                                                 url release_date  \
0  http://store.steampowered.com/app/761140/Lost_…   2018-01-04
1  http://store.steampowered.com/app/643980/Ironb…   2018-01-04
2  http://store.steampowered.com/app/670290/Real_…   2017-07-24
3     http://store.steampowered.com/app/767400/2222/   2017-12-07
4  http://store.steampowered.com/app/773570/Log_C…          NaN

                                                tags  discount_price  \
0  ['Strategy', 'Action', 'Indie', 'Casual', 'Sim…           4.49
1  ['Free to Play', 'Strategy', 'Indie', 'RPG', '…            NaN
2  ['Free to Play', 'Simulation', 'Sports', 'Casu…            NaN
3                  ['Action', 'Adventure', 'Casual']           0.83
4            ['Action', 'Indie', 'Casual', 'Sports']           1.79

                                         reviews_url  \
0  http://steamcommunity.com/app/761140/reviews/?…
1  http://steamcommunity.com/app/643980/reviews/?…
2  http://steamcommunity.com/app/670290/reviews/?…
3  http://steamcommunity.com/app/767400/reviews/?…
```

```
4  http://steamcommunity.com/app/773570/reviews/?…

                                              specs         price  \
0                                  ['Single-player']          4.99
1  ['Single-player', 'Multi-player', 'Online Mult…  Free To Play
2  ['Single-player', 'Multi-player', 'Online Mult…  Free to Play
3                                  ['Single-player']          0.99
4  ['Single-player', 'Full controller support', '…          2.99

   early_access        id         developer        sentiment  metascore
0         False  761140.0         Kotoshiro              NaN        NaN
1         False  643980.0  Secret Level SRL  Mostly Positive        NaN
2         False  670290.0      Poolians.com  Mostly Positive        NaN
3         False  767400.0                              NaN        NaN
4         False  773570.0               NaN              NaN        NaN
```

1.2 Additional Preprocessing

1.2.1 Create interaction matrix

We will create an interactions matrix using the user-item data. This is done using the `create_interaction_matrix` function, which can be found in `support_function.py`.

[ ]:
```python
inter_mat = build_matrix(data_frame= user_recom_data,
                                        u_column = 'uid',
                                        i_column = 'id',
                                        r_column = 'owned')
inter_mat.shape
```

[ ]:
```
(8769, 8171)
```

From the shape, we note that we have 8769 unique users and 8171 different games represented.

[ ]:
```python
# Preview head
inter_mat.head(10)
```

[ ]:
```
id   10       20       30       40       50       60       70       80       130      \
uid
0        1.0      1.0      1.0      1.0      1.0      1.0      1.0      0.0      1.0
1        1.0      1.0      1.0      1.0      1.0      1.0      1.0      1.0      1.0
2        0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
3        1.0      1.0      1.0      1.0      1.0      1.0      1.0      1.0      1.0
4        1.0      1.0      1.0      1.0      1.0      1.0      1.0      1.0      1.0
5        0.0      0.0      0.0      0.0      1.0      0.0      0.0      0.0      0.0
6        0.0      1.0      0.0      0.0      1.0      0.0      1.0      0.0      1.0
7        0.0      0.0      0.0      0.0      0.0      0.0      1.0      0.0      0.0
8        0.0      1.0      0.0      0.0      1.0      0.0      1.0      0.0      1.0
10       1.0      1.0      1.0      1.0      1.0      1.0      1.0      1.0      1.0
```

```
id   220      …  525190  526460  526790  527340  527440  527510  527520  \
uid           …
0       1.0   …     0.0     0.0     0.0     0.0     0.0     0.0     0.0
1       1.0   …     0.0     0.0     0.0     0.0     0.0     0.0     0.0
2       1.0   …     0.0     0.0     0.0     0.0     0.0     0.0     0.0
3       1.0   …     0.0     0.0     0.0     0.0     0.0     0.0     0.0
4       1.0   …     0.0     0.0     0.0     0.0     0.0     0.0     0.0
5       1.0   …     0.0     0.0     0.0     0.0     0.0     0.0     0.0
6       1.0   …     0.0     0.0     0.0     0.0     0.0     0.0     0.0
7       1.0   …     0.0     0.0     0.0     0.0     0.0     0.0     0.0
8       1.0   …     0.0     0.0     0.0     0.0     0.0     0.0     0.0
10      1.0   …     0.0     0.0     0.0     0.0     0.0     0.0     0.0

id   527810  527900  530720
uid
0       0.0     0.0     0.0
1       0.0     0.0     0.0
2       0.0     0.0     0.0
3       0.0     0.0     0.0
4       0.0     0.0     0.0
5       0.0     0.0     0.0
6       0.0     0.0     0.0
7       0.0     0.0     0.0
8       0.0     0.0     0.0
10      0.0     0.0     0.0

[10 rows x 8171 columns]
```

1.2.2 Break Down the dataset into train and test

[ ]:
```
# Get number of users
len(inter_mat)
```

[ ]:
```
8769
```

We choose to have roughly 80% of our data as training and 20% as test.

[ ]:
```
# Establish number of users in train/test sets

train_num = round((80/100)*len(inter_mat),0)
print(f'We desire {train_num} users in our training set.')

test_num = len(inter_mat)-train_num
print(f'We desire {test_num} users in our test set.')
```

```
We desire 7015.0 users in our training set.
We desire 1754.0 users in our test set.
```

[ ]:
```python
# Define train and test sets
train = inter_mat[:7015]
test = inter_mat[7015:]
```

1.2.3 Build Player Dictionary

[ ]:
```python
# Create user dictionary using helper function
player_dic = build_dic_user(matrix_inter=inter_mat)
```

1.2.4 Build Game Dictionary

[ ]:
```python
# Create game dictionary using helper function
dic_game = build_dic_item(data_frame=game_recom_data, column_id= 'id',␣
↪column_n='title')
```

1.2.5 Build Sparse Matrix

We will transform the interaction into a sparse matrix, to make computations efficient.

For the trainset, we simply use the `sparse.csr_matrix()` function.

With the test set, due to a known issue, we need to add additional rows so that the number of rows matches the trains set.

[ ]:
```python
# Create sparse matrices for evaluation
train_sparse = sparse.csr_matrix(train.values)

#Add X users to Test so that the number of rows in Train match Test
N = train.shape[0] #Rows in Train set
n,m = test.shape #Rows & columns in Test set
z = np.zeros([(N-n),m]) #Create the necessary rows of zeros with m columns
#test = test.toarray() #Temporarily convert Test into a numpy array
test = np.vstack((test,z)) #Vertically stack Test on top of the blank users
test_sparse = sparse.csr_matrix(test) #Convert back to sparse
```

1.3 Using Hybrid Model LightFM for the Recommendation

1.3.1 Input WARP loss model

[ ]:
```python
mf_model_warp = apply_model(matrix_inter= train,
                 component_val= 30,
                 loss = 'warp',
                 epoch = 30,
                 n_jobs = 4)
```

[ ]:
```python
train_precision = precision_at_k(mf_model_warp, train_sparse, k=10).mean()
test_precision = precision_at_k(mf_model_warp, test_sparse, k=10).mean()
print('Precision: train %.2f, test %.2f.' % (train_precision, test_precision))
```

```
Precision: train 0.73, test 0.43.
```

[ ]:
```
train_auc = auc_score(mf_model_warp, train_sparse).mean()
test_auc = auc_score(mf_model_warp, test_sparse).mean()
print('AUC: train %.2f, test %.2f.' % (train_auc, test_auc))
```

```
AUC: train 0.98, test 0.92.
```

AUC score is very good on both train and test

1.3.2 Input BPR loss model

[ ]:
```
mf_model_bpr = apply_model(matrix_inter= train,
                 component_val= 30,
                 loss = 'bpr',
                 epoch = 30,
                 n_jobs = 4)
```

[ ]:
```
train_precision = precision_at_k(mf_model_bpr, train_sparse, k=10).mean()
test_precision = precision_at_k(mf_model_bpr, test_sparse, k=10).mean()
print('Precision: train %.2f, test %.2f.' % (train_precision, test_precision))
```

```
Precision: train 0.80, test 0.36.
```

[ ]:
```
train_auc = auc_score(mf_model_bpr, train_sparse).mean()
test_auc = auc_score(mf_model_bpr, test_sparse).mean()
print('AUC: train %.2f, test %.2f.' % (train_auc, test_auc))
```

```
AUC: train 0.96, test 0.71.
```

Again, the AUC score is good, though significantly lower for the test set compare to the train set.

Based on these two models, we will keep WARP as the loss function due to better performance all round.

1.3.3 Hyper Tuning of the model by varing components

The `n_components` parameter controlls the number of embeddings (dimension of the features in the latent space.)

We will vary this number, lowering it to `10` first and then increasing it to `50` to see how this affects model performance.

[ ]:
```
mf_model_warp_2 = apply_model(matrix_inter= train,
                 component_val= 10,
                 loss = 'warp',
                 epoch = 30,
                 n_jobs = 4)
```

[ ]:
```
train_precision = precision_at_k(mf_model_warp_2, train_sparse, k=10).mean()
test_precision = precision_at_k(mf_model_warp_2, test_sparse, k=10).mean()
```

```
print('Precision: train %.2f, test %.2f.' % (train_precision, test_precision))
```

Precision: train 0.68, test 0.48.

[ ]:
```
train_auc = auc_score(mf_model_warp_2, train_sparse).mean()
test_auc = auc_score(mf_model_warp_2, test_sparse).mean()
print('AUC: train %.2f, test %.2f.' % (train_auc, test_auc))
```

AUC: train 0.97, test 0.93.

[ ]:
```
mf_model_warp_50 = apply_model(matrix_inter= train,
                 component_val= 50,
                 loss = 'warp',
                 epoch = 30,
                 n_jobs = 4)
```

[ ]:
```
train_precision = precision_at_k(mf_model_warp_50, train_sparse, k=10).mean()
test_precision = precision_at_k(mf_model_warp_50, test_sparse, k=10).mean()
print('Precision: train %.2f, test %.2f.' % (train_precision, test_precision))
```

Precision: train 0.76, test 0.42.

[ ]:
```
train_auc = auc_score(mf_model_warp_50, train_sparse).mean()
test_auc = auc_score(mf_model_warp_50, test_sparse).mean()
print('AUC: train %.2f, test %.2f.' % (train_auc, test_auc))
```

AUC: train 0.99, test 0.91.

In the end performance is not change on the base of component

1.3.4 Build Model

[ ]:
```
# Instantiate and fit model on full interactions set
light_fm_mode = apply_model(matrix_inter= inter_mat,
                 component_val = 30,
                 loss = 'warp',
                 epoch = 30,
                 n_jobs = 4)
```

1.4 Embeddings

Apply Embedding Space of the Model

1.4.1 Retrieve embeddings matrix

[ ]:
```
# Get embeddings
embeddings = light_fm_mode.item_embeddings
embeddings
```

```
[ ]: array([[-0.07690857,  0.66486156,  0.7936622 , …,  0.14951605,
         -0.0695671 , -0.6245182 ],
        [-0.60291576,  0.83658946,  0.58764905, …,  0.5114703 ,
         -0.3604954 , -1.0809734 ],
        [-0.2310924 ,  1.0992005 ,  0.64228845, …,  0.98967004,
          0.06214582, -0.49858683],
        …,
        [ 0.64778465, -0.10613031,  0.09715862, …,  0.57438576,
         -0.2034148 , -0.07921824],
        [ 0.27167612,  0.5803558 , -0.41966903, …,  0.6099575 ,
          0.5862158 , -0.12392855],
        [ 0.35757646,  0.32205895, -0.3167676 , …,  0.53355885,
          0.01019462,  0.25211778]], dtype=float32)
```

```
[ ]: embeddings.shape
```

```
[ ]: (8171, 30)
```

Check the Game Vector

```
[ ]: embeddings[0]
```

```
[ ]: array([-0.07690857,  0.66486156,  0.7936622 ,  0.40528223, -0.145565  ,
        -0.36309764, -0.34237215,  0.15373814,  0.54323393, -0.5631929 ,
        -0.61242783, -0.29522717,  0.5400072 ,  0.34600753, -0.74698734,
        -0.2089371 ,  0.31638432, -0.23969008, -0.64567953, -0.39736956,
         0.1493338 ,  0.21329583,  0.7203192 , -0.6489853 , -0.0677067 ,
        -0.31437442,  0.27613798,  0.14951605, -0.0695671 , -0.6245182 ],
       dtype=float32)
```

Find the game name from the matrix

```
[ ]: firstgameid = inter_mat.columns[0]
     dic_game[firstgameid]
```

```
[ ]: 'Counter-Strike'
```

1.4.2 Pair similarity

Let find the distance between the similar game

We search the 'Counter-Strike' game

```
[ ]: game_recom_data[(game_recom_data['title']=='Counter-Strike') |␣
      ↪(game_recom_data['title']=='Left 4 Dead 2') ]
```

```
[ ]:       publisher      genres        app_name           title  \
     31529     Valve  ['Action']   Left 4 Dead 2   Left 4 Dead 2
     32106     Valve  ['Action']  Counter-Strike  Counter-Strike
```

```
                                                     url release_date  \
31529  http://store.steampowered.com/app/550/Left_4_D…   2009-11-16
32106  http://store.steampowered.com/app/10/CounterSt…   2000-11-01

                                                    tags  discount_price  \
31529  ['Zombies', 'Co-op', 'FPS', 'Multiplayer', 'Ac…             NaN
32106  ['Action', 'FPS', 'Multiplayer', 'Shooter', 'C…             NaN

                                             reviews_url  \
31529  http://steamcommunity.com/app/550/reviews/?bro…
32106  http://steamcommunity.com/app/10/reviews/?brow…

                                                   specs  price  early_access  \
31529  ['Single-player', 'Multi-player', 'Co-op', 'St…  19.99         False
32106       ['Multi-player', 'Valve Anti-Cheat enabled']   9.99         False

          id developer                sentiment  metascore
31529  550.0     Valve  Overwhelmingly Positive       89.0
32106   10.0     Valve  Overwhelmingly Positive       88.0
```

Check the Vector of the games

[ ]:
```python
cs_index = 0
cs_vector = embeddings[cs_index]
cs_vector
```

[ ]:
```
array([-0.07690857,  0.66486156,  0.7936622 ,  0.40528223, -0.145565  ,
       -0.36309764, -0.34237215,  0.15373814,  0.54323393, -0.5631929 ,
       -0.61242783, -0.29522717,  0.5400072 ,  0.34600753, -0.74698734,
       -0.2089371 ,  0.31638432, -0.23969008, -0.64567953, -0.39736956,
        0.1493338 ,  0.21329583,  0.7203192 , -0.6489853 , -0.0677067 ,
       -0.31437442,  0.27613798,  0.14951605, -0.0695671 , -0.6245182 ],
      dtype=float32)
```

[ ]:
```python
lfd2_id = game_recom_data[game_recom_data['title']=='Left 4 Dead 2']['id'].
 ↪values[0]
lfd2_index = list(inter_mat.columns).index(lfd2_id)
lfd2_vector = embeddings[lfd2_index]
lfd2_vector
```

[ ]:
```
array([-0.01273242, -0.07405546,  0.6101665 ,  0.1412955 , -0.330248  ,
       -0.9404025 , -0.29786164, -0.25623107,  0.19409557,  0.40056136,
       -0.60454905,  0.01597847,  0.29765967,  1.0109664 , -0.6728011 ,
        0.5028252 , -0.14399414, -0.2512675 , -0.32039464, -0.43069765,
        0.16283731,  0.60680556,  0.1759727 , -0.2787006 , -0.5939248 ,
        0.5459706 ,  0.28189695, -0.43314165, -0.60124415, -0.62766606],
      dtype=float32)
```

To assign a single value to the similarity between these two vectors, we calculate the distance between them. Let us first compute the Euclidean distance.

```
[ ]: # Compute Euclidean distance
     distance.euclidean(cs_vector, lfd2_vector)
```

```
[ ]: 2.4286489486694336
```

Let us compare this figure with a pair of games we believe to be very different.

```
[ ]: # Get data for both games
     game_recom_data[(game_recom_data['title']=='Counter-Strike') |␣
      ↪(game_recom_data['title']=='The Room') ]
```

```
[ ]:              publisher                     genres        app_name  \
     2472   Fireproof Games  ['Adventure', 'Indie']        The Room
     32106            Valve                ['Action']  Counter-Strike

                     title                                              url  \
     2472         The Room  http://store.steampowered.com/app/288160/The_R…
     32106  Counter-Strike  http://store.steampowered.com/app/10/CounterSt…

           release_date                                              tags  \
     2472    2014-07-28  ['Puzzle', 'Adventure', 'Point & Click', 'Indi…
     32106   2000-11-01  ['Action', 'FPS', 'Multiplayer', 'Shooter', 'C…

            discount_price                                      reviews_url  \
     2472              NaN  http://steamcommunity.com/app/288160/reviews/?…
     32106             NaN  http://steamcommunity.com/app/10/reviews/?brow…

                                                    specs price  early_access  \
     2472   ['Single-player', 'Steam Achievements', 'Steam…   4.99         False
     32106       ['Multi-player', 'Valve Anti-Cheat enabled']  9.99         False

                  id        developer                 sentiment  metascore
     2472   288160.0  Fireproof Games  Overwhelmingly Positive       73.0
     32106      10.0            Valve  Overwhelmingly Positive       88.0
```

```
[ ]: # Retrieve game id for The Room
     room_id = game_recom_data[game_recom_data['title']=='The Room']['id'].values[0]

     # Obtain index for Squad in interactions matrix
     room_index = list(inter_mat.columns).index(room_id)

     # Obtain embeddings vector
     room_vector = embeddings[room_index]

     room_vector
```

[ ]: array([-0.1024242 , 0.4752257 , 0.24124612, -0.00741749, 0.21419159,
       -0.28054076, -0.03180434, -0.38254467, 0.13352183, -0.33322603,
        0.13092154, -0.15414314, 0.00489135, -0.19807154, -0.33829376,
       -0.07191804, -0.17468366, 0.18996401, 0.08875996, 0.30820638,
        0.35630605, 0.00255273, -0.5786068 , 0.22534879, 0.0135782 ,
       -0.45574978, -0.27468544, -0.31314114, -0.21707602, -0.04487913],
      dtype=float32)

[ ]:
```
# Compute Euclidean distance
distance.euclidean(cs_vector, room_vector)
```

[ ]: 2.738154172897339

Check the distance with cosine distance

[ ]:
```
print(f'Cosine distance between Counter Strike and Left 4 Dead 2: {distance.
 ↪cosine(cs_vector, lfd2_vector)}')
print(f'Cosine distance between Counter Strike and The Room: {distance.
 ↪cosine(cs_vector, room_vector)}')
```

```
Cosine distance between Counter Strike and Left 4 Dead 2: 0.4738824963569641
Cosine distance between Counter Strike and The Room: 0.9319570809602737
```

1.4.3 Exploring embeddings with Gensim

[ ]:
```
embedding_size = embeddings.shape[1]
kv = Word2VecKeyedVectors(embedding_size)

gameslist = []
for game_id in inter_mat.columns:
    name = dic_game[game_id]
    gameslist.append(name)

kv.add_vectors(gameslist, embeddings)
```

Let us obtain the games closest to `Counter-Strike`.

[ ]:
```
kv.most_similar('Counter-Strike')
```

[ ]:
```
[('Counter-Strike: Condition Zero', 0.9755569100379944),
 ('Day of Defeat', 0.8177651762962341),
 ('Half-Life: Source', 0.8058030009269714),
 ('Day of Defeat: Source', 0.8011133074760437),
 ('Team Fortress Classic', 0.7981202006340027),
 ('Half-Life: Blue Shift', 0.7888646721839905),
 ('Half-Life', 0.7878614068031311),
 ('Ricochet', 0.7845215797424316),
 ('Deathmatch Classic', 0.7804338335990906),
 ('Half-Life: Opposing Force', 0.7775993347167969)]
```

[ ]:
```
kv.most_similar('Left 4 Dead 2')
```

[ ]:
```
[('PAYDAY  The Heist', 0.9239243865013123),
 ('Borderlands 2', 0.8823978900909424),
 ("Garry's Mod", 0.8753825426101685),
 ('Counter-Strike: Global Offensive', 0.8716615438461304),
 ('Killing Floor', 0.8585674166679382),
 ('Defence Alliance 2', 0.8505985140800476),
 ('The Ship: Murder Party', 0.842189610004425),
 ('Saints Row IV', 0.8398149609565735),
 ('Terraria', 0.8383126854896545),
 ('Chivalry: Medieval Warfare', 0.8292756676673889)]
```

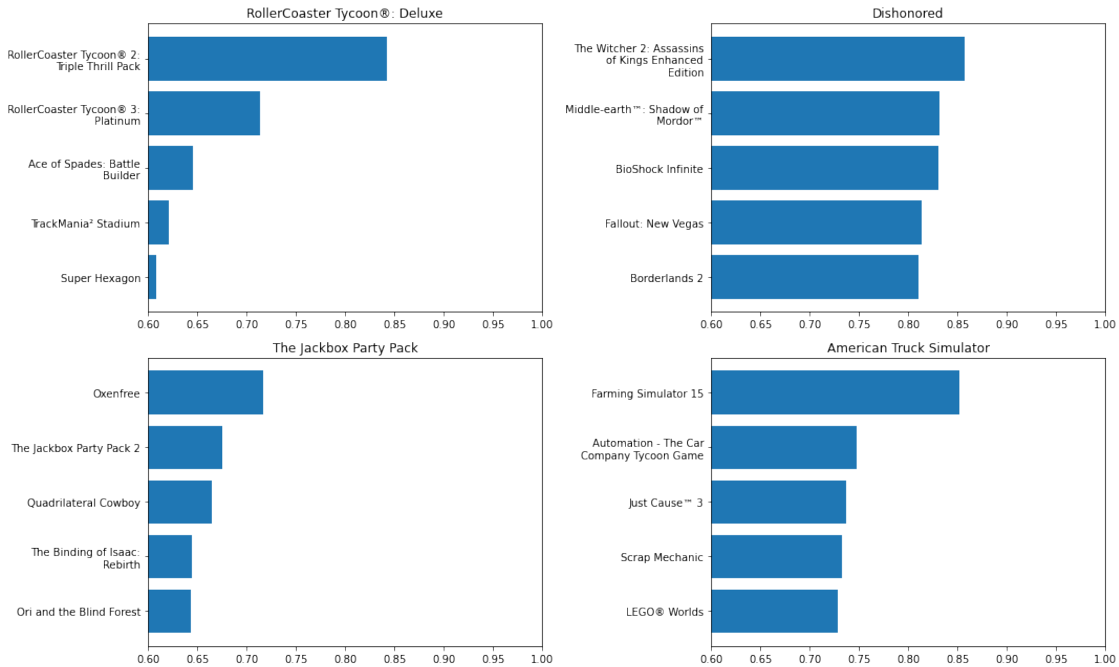
[ ]:
```
def build_graph(game, x, best_num=5):
    sim = kv.most_similar(game, topn=best_num)[::-1]
    y = np.arange(len(sim))
    w = [t[1] for t in sim]
    x.barh(y, w)
    left = min(.6, min(w))
    x.set_xlim(right=1.0, left=left)
    # Split long titles over multiple lines
    labels = [textwrap.fill(t[0] , width=24)
              for t in sim]
    x.set_yticks(y)
    x.set_yticklabels(labels)
    x.set_title(game)
```

[ ]:
```
list_game = ['RollerCoaster Tycoon®: Deluxe', 'Dishonored',
         'The Jackbox Party Pack', 'American Truck Simulator']

figure, ax = plt.subplots(2, 2, figsize=(15, 9))

for game, ax in zip(list_game, ax.flatten()):
    build_graph(game, ax)

figure.tight_layout()
```



1.5 User Recommendations

1.5.1 Recommendations for existing user

[ ]:
```
# Get recommendations
rec_list_u12 = find_recom(rec_mode= light_fm_mode,
                    matrix_inter= inter_mat,
                    player_id= 5000,
                    dic_player= player_dic,
                    dic_game= dic_game,
                    threshold = 0,
                    num_items = 5,
                    show_known = True,
                    show_recs = True)
```

```
Games Likes:
1- Dungeon Fighter Online
2- ESEA
3- H1Z1 Test Server
4- H1Z1
5- CS:GO Player Profiles
6- Just Survive Test Server
7- AdVenture Capitalist
8- Strife®
9- Dirty Bomb®
10- Game of Thrones - A Telltale Games Series
```

11- Don't Starve Together
12- Unturned
13- Robocraft
14- Mount Your Friends
15- Warface
16- Fistful of Frags
17- The Walking Dead: Season 2
18- Rust
19- Toribash
20- Heroes & Generals
21- FEZ
22- No More Room in Hell
23- Cry of Fear
24- Insurgency
25- Hotline Miami
26- MapleStory
27- The Walking Dead
28- Castle Crashers®
29- Max Payne 3
30- Mount & Blade: Warband
31- Super Meat Boy
32- Defence Alliance 2
33- TrackMania Nations Forever
34- BioShock Infinite
35- Just Cause 2
36- Garry's Mod
37- Killing Floor
38- Counter-Strike: Global Offensive
39- Left 4 Dead 2
40- Left 4 Dead
41- Half-Life 2: Episode Two
42- Portal
43- Half-Life 2: Episode One
44- Half-Life Deathmatch: Source
45- Half-Life 2: Lost Coast
46- Half-Life 2: Deathmatch
47- Counter-Strike: Source
48- Half-Life 2

Game Recommended Items:
1- Portal 2
2- Terraria
3- Rocket League®
4- Grand Theft Auto V
5- Warframe

1.6 Item Recommendations

1.6.1 Create item embedding matrix

```
[ ]: game_mat_data =  build_embedding_mat(rec_mode=light_fm_mode,␣
      ↪matrix_inter=inter_mat)
```

```
[ ]: game_mat_data.shape
```

```
[ ]: (8171, 8171)
```

```
[ ]: game_mat_data.head()
```

```
[ ]: id    10        20        30        40        50        60        70      \
     id
     10  1.000000  0.798120  0.817765  0.780434  0.777599  0.784522  0.787861
     20  0.798120  1.000000  0.867307  0.852161  0.994024  0.866077  0.977754
     30  0.817765  0.867307  1.000000  0.990534  0.862059  0.990114  0.843498
     40  0.780434  0.852161  0.990534  1.000000  0.849804  0.994848  0.820985
     50  0.777599  0.994024  0.862059  0.849804  1.000000  0.862647  0.981975

     id    80        130       220     …    525190    526460    526790    527340  \
     id                                …
     10  0.975557  0.788865  0.720709  … -0.306754 -0.330438 -0.341211 -0.054234
     20  0.699381  0.995552  0.846169  … -0.293373 -0.205190 -0.240755 -0.133135
     30  0.719655  0.871238  0.718637  … -0.162556 -0.096175 -0.150723 -0.181699
     40  0.670797  0.858557  0.672284  … -0.095033 -0.022256 -0.077084 -0.152839
     50  0.675560  0.996402  0.849154  … -0.301745 -0.195885 -0.240017 -0.145447

     id    527440    527510    527520    527810    527900    530720
     id
     10 -0.361544 -0.485556 -0.328589 -0.066259 -0.281063 -0.482814
     20 -0.242896 -0.352428 -0.174543 -0.130799 -0.206378 -0.334659
     30 -0.069702 -0.258437 -0.061448  0.054523 -0.009513 -0.191741
     40 -0.026975 -0.190437  0.011434  0.098432  0.068500 -0.126358
     50 -0.224202 -0.325862 -0.143163 -0.115081 -0.192277 -0.309017

     [5 rows x 8171 columns]
```

1.6.2 Generate item recommendations

```
[ ]: item_rec_list_10 = return_recomm( embedd_mat= game_mat_data,
                                       game_id= 10,
                                       dic_game= dic_game,
                                       n_items = 6,
                                       show = True)
```

```
Item of interest: Counter-Strike
Similar items:
```

```
1- Counter-Strike: Condition Zero
2- Day of Defeat
3- Half-Life: Source
4- Day of Defeat: Source
5- Team Fortress Classic
6- Half-Life: Blue Shift
```

[ ]:
```python
game_recom_data[game_recom_data['title'] == 'The Witness']
```

[ ]:
```
        publisher                     genres     app_name        title  \
5211  Thekla, Inc.  ['Adventure', 'Indie']  The Witness  The Witness

                                                   url release_date  \
5211  http://store.steampowered.com/app/210970/The_W…   2016-01-26

                                                 tags  discount_price  \
5211  ['Puzzle', 'Exploration', 'First-Person', 'Sin…             NaN

                                          reviews_url  \
5211  http://steamcommunity.com/app/210970/reviews/?…

                                                specs  price  early_access  \
5211  ['Single-player', 'Steam Achievements', 'Capti…  39.99         False

            id     developer      sentiment  metascore
5211  210970.0  Thekla, Inc.  Very Positive       87.0
```

[ ]:
```python
game_210970 = return_recomm( embedd_mat= game_mat_data,
                              game_id = 210970,
                              dic_game= dic_game,
                              n_items = 5,
                              show = True)
```

```
Item of interest: The Witness
Similar items:
1- Bear Simulator
2- Everybody's Gone to the Rapture
3- OPUS: The Day We Found Earth
4- ABZU
5- Dangerous Golf
```

[ ]:
```python
game_recom_data[game_recom_data['title'] == 'ABZU']
```

[ ]:
```
       publisher                                             genres app_name  \
22123  505 Games  ['Action', 'Adventure', 'Casual', 'Indie', 'Si…     ABZU

      title                                         url release_date  \
22123  ABZU  http://store.steampowered.com/app/384190/ABZU/   2016-08-02
```

```
                                                    tags  discount_price  \
22123  ['Relaxing', 'Atmospheric', 'Underwater', 'Gre…             NaN

                                             reviews_url  \
22123  http://steamcommunity.com/app/384190/reviews/?…

                                                   specs  price  early_access  \
22123  ['Single-player', 'Steam Achievements', 'Full …  19.99         False

             id    developer      sentiment  metascore
22123  384190.0  Giant Squid  Very Positive       83.0
```

[ ]:
```
game_384190 = return_recomm( embedd_mat= game_mat_data,
                             game_id = 384190,
                             dic_game= dic_game,
                             n_items = 6,
                             show = True)
```

```
Item of interest: ABZU
Similar items:
1- Quadrilateral Cowboy
2- The Witness
3- Valley
4- Replica
5- 1979 Revolution: Black Friday
6- Everybody's Gone to the Rapture
```